Revised Corridor Description
June 9, 2011

4.0 Engineering and Operational Design

The information in Section 4.0 is subject to change as Project development continues. These sections and updated engineering and operation design information will be finalized in Minnkota's application for a Route Permit.

4.1 Corridor Description

The Project Corridor is approximately 248-miles-long. The Project Corridor proceeds northeast out of the Center 345 kV Substation for about 0.5 miles to the section line, then proceeds due east along the section line for about 8 miles, before turning northeast on a cross-country path for about 1 mile. The Project Corridor then proceeds east for approximately 3 miles to the Missouri River. It crosses the Missouri River about 0.10 miles north of the existing HVDC transmission line on the west side of the river and about 0.4 miles north of the existing HVDC transmission line on the east side of the river. After crossing the Missouri River and State Highway 1804 diagonally for about 2 miles, the Project Corridor proceeds due east along 279th Ave NE for about 2.25 miles. The Project Corridor then proceeds north for about 0.5 miles before turning northwest for about 2.25 miles. The Project Corridor then proceeds north for about 3.75 miles along a section line, and then east for about 5.5 miles along a quarter-section line to within 0.5 miles west of State Highway 41.

The Project Corridor proceeds north for about 8.0 miles along State Highway 41, turns east for 2 miles along State Highway 41, and follows State Highway 41 to the north for about 9 miles; within this segment the Project Corridor spans the McClusky Canal. The Project Corridor turns east for approximately 2 miles along 3rd Street NW to the McLean/Sheridan County line. The Project Corridor proceeds diagonally, cross-country for about 10 miles to the east side of Center Ave in Sheridan County. At that point the Project Corridor proceeds east about 0.25 miles north of 10th St NE for about 28.25 miles to 0.25 miles west of State Highway 3, crossing the McClusky Canal and State Highway 14, then proceeds north for about 2 miles. The Project Corridor turns east along 12th St NE for about 15.75 miles, crossing U.S. Highway 52, then turns north for about 1.5 miles on a quarter-section line. The Project Corridor turns east along a quarter-section line for about 27 miles, crossing State Highway 30 and U.S. Highway 281. Then the Project Corridor turns south for about 1 mile to the quarter-section line, and continues east for about 4 miles along the quarter-section line to turn south for about 0.5 miles to the quarter-section line north of 12th St NE (Foster/Eddy County line) where it travels approximately 12 miles to the east.

To bypass the towns of McHenry and Binford, the Project Corridor goes south for approximately 3 miles, then east for about 12.5 miles along 3rd St NE/9th St NE, and north for about 3 miles to 12th St NE. Along 12th St NE, the Project Corridor heads east for about 20.5 miles, across the Sheyenne River and State Highway 45, to about 0.5 miles east of 120th Ave NE in Steele County where the Project Corridor travels north for about 6 miles on the quarter-section to Aneta. At Aneta, the Project Corridor goes northeast, diagonally, cross-country for about 7.5 miles to 6th Ave NE in Grand Forks County. The Project Corridor travels east along 6th Ave NE for about 7.75 miles, then north for about 0.2 miles along 41st St NE. The Project Corridor then proceeds east for about 9.5 miles and turns north for about 2 miles along the quarter-section line (about 0.5 miles west of 31st St NE). Then the Project Corridor travels east along 8th Ave NE for about 4.5 miles. At 27th St NE, the Project Corridor travels north for about 0.5 miles and then travels east for about 4 miles to the existing WAPA 230 kV transmission line. Then, the Project Corridor proceeds northeast, diagonally, cross-country for

about 4.5 miles adjacent to the WAPA line, then north for about 4 miles, approximately 0.25 miles west of 19th St NE, where it turns to go east for almost 5 miles. At 0.5 miles west of 14th St NE, the Project Corridor heads north for about 0.5 miles and then proceeds east for about 1.5 miles into the Prairie Substation

4.2 Description of Proposed Facilities

In general, a high-voltage transmission line consists of three phases, each at the end of a separate insulator string (or v-string configuration), all physically supported by structures. Each phase consists of one or more conductors. When more than one conductor is used to make up a phase, the term "bundled" conductors is used. Conductors are metal cables consisting of multiple strands of steel and aluminum wire wound together. There are also two shield wires strung above the electrical phases to prevent, to the extent possible, lighting from striking the phases. These wires are typically less than 1 inch in diameter. The shield wire can also include fiber optic cable that allows a path for substation protection and control equipment to communicate to equipment at other terminals on the transmission line. Transmission lines are constructed on a ROW, whose width is primarily dependent on structure design, span length, and the electrical safety requirements associated with the transmission line's voltage.

4.2.1 Transmission Structure and Right-of-Way Design

Transmission Structure

Single pole, self-weathering steel single circuit structures are proposed for the majority of the Project (Figure 5). The self-weathering steel oxidizes or rusts to form a dark reddish brown surface coating to protect the structure from further weathering. The steel single poles are placed on large concrete foundations, which are wider than the pole base. Table 4.2-1 outlines typical characteristics of 345 kV transmission line structures.

Table 4.2-1. Typical Characteristics of 345 kV Transmission Line Structures

345 kV Transmission Line	Details
Voltage (kV)	345 kV
ROW width (feet)	150
Approximate span length (feet)	1,000
Range of structure heights (feet)	130 - 150
Number of structures per mile	5 - 7
Minimum ground clearance beneath conductor (feet)	35 - 40
Depth of concrete footings for the poles (feet)	30 - 40
Diameter of concrete footings for the poles (feet)	7 - 10
Average area of permanent disturbance per structure (square feet)	78.5

Table 4.2-2 summarizes the structure designs and foundations for the single pole structures that will be used for the majority of the Project. Preliminary information about the Missouri River structures and structures near the Grand Forks Airport is also provided.